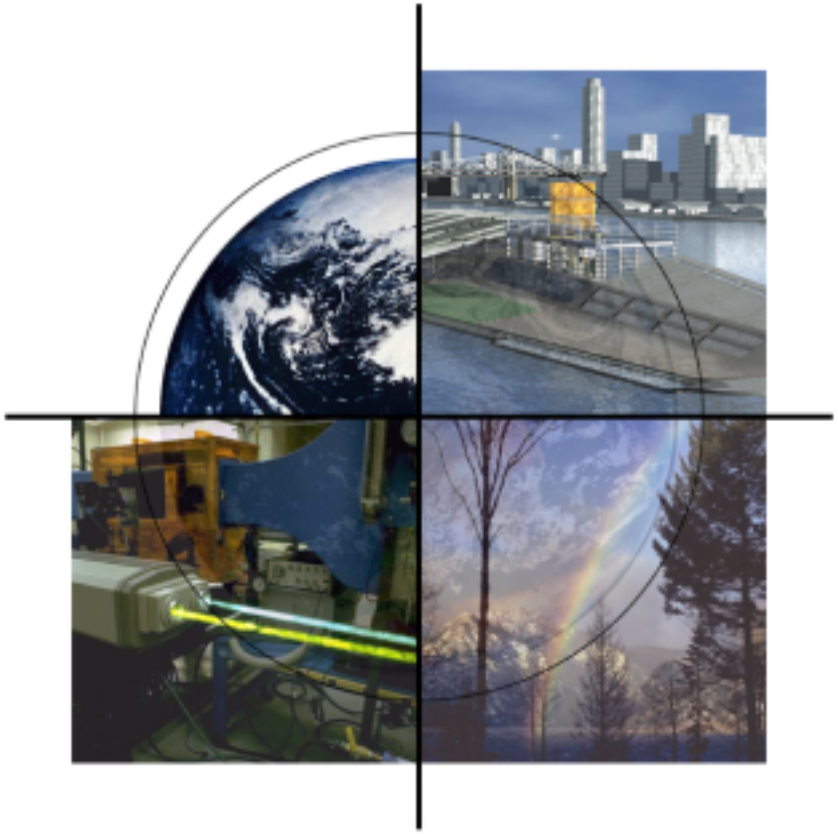
CCPI Round 2 & *FutureGen* Update



CURC
Technical Subcommittee Meeting

Atlanta, GA
April 14, 2004

Mike Eastman, Technology Manager
National Energy Technology Laboratory

Clean Coal Power Initiative (CCPI)

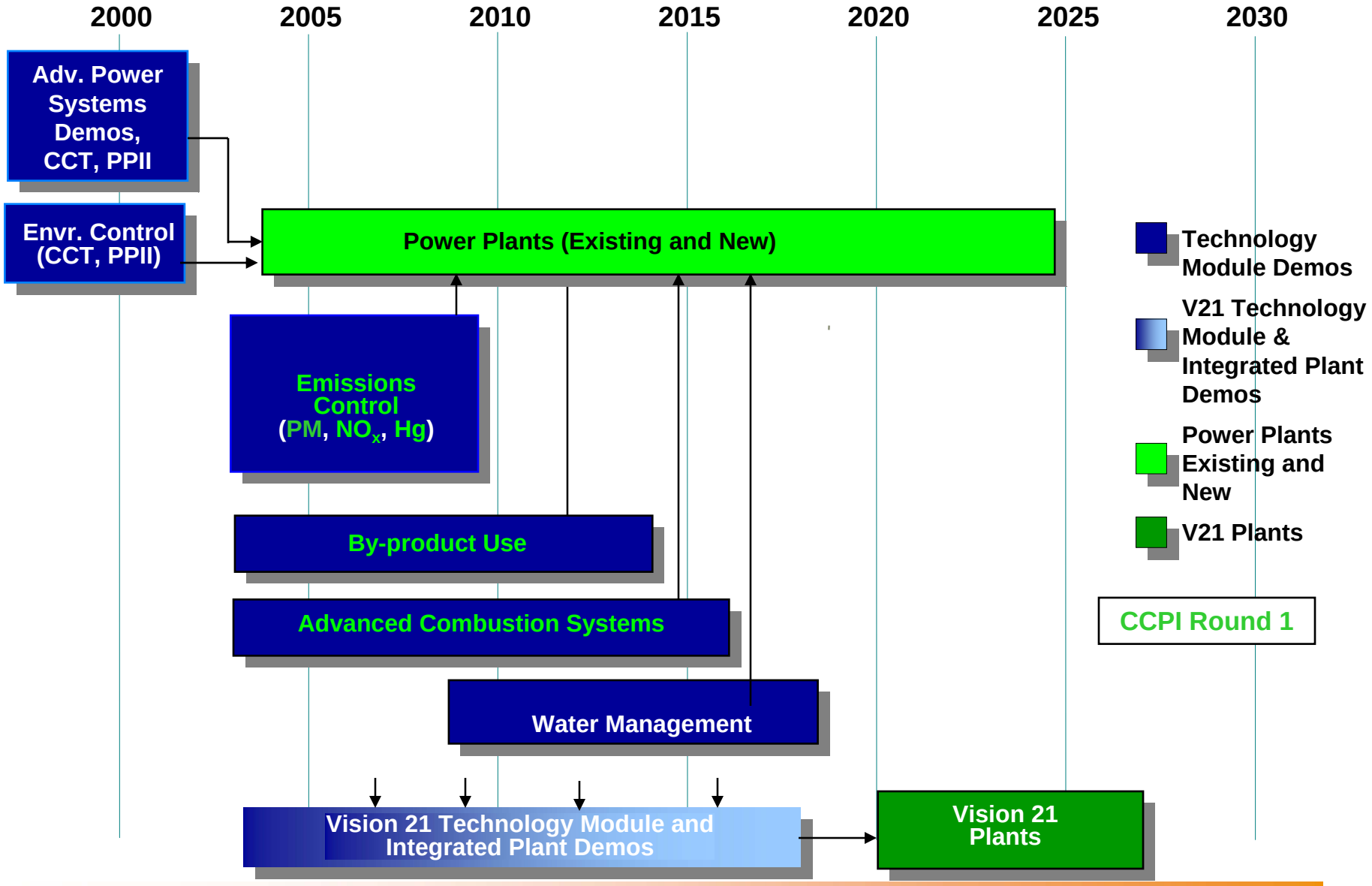
- **Drivers**
  - Clear Skies Initiative
  - Reduced carbon intensity
  - Zero emissions technology goals
  - Energy/economic security

Round 1 (Broad)
- Advanced coal-based power generation
- Efficiency, environmental & economic improvements

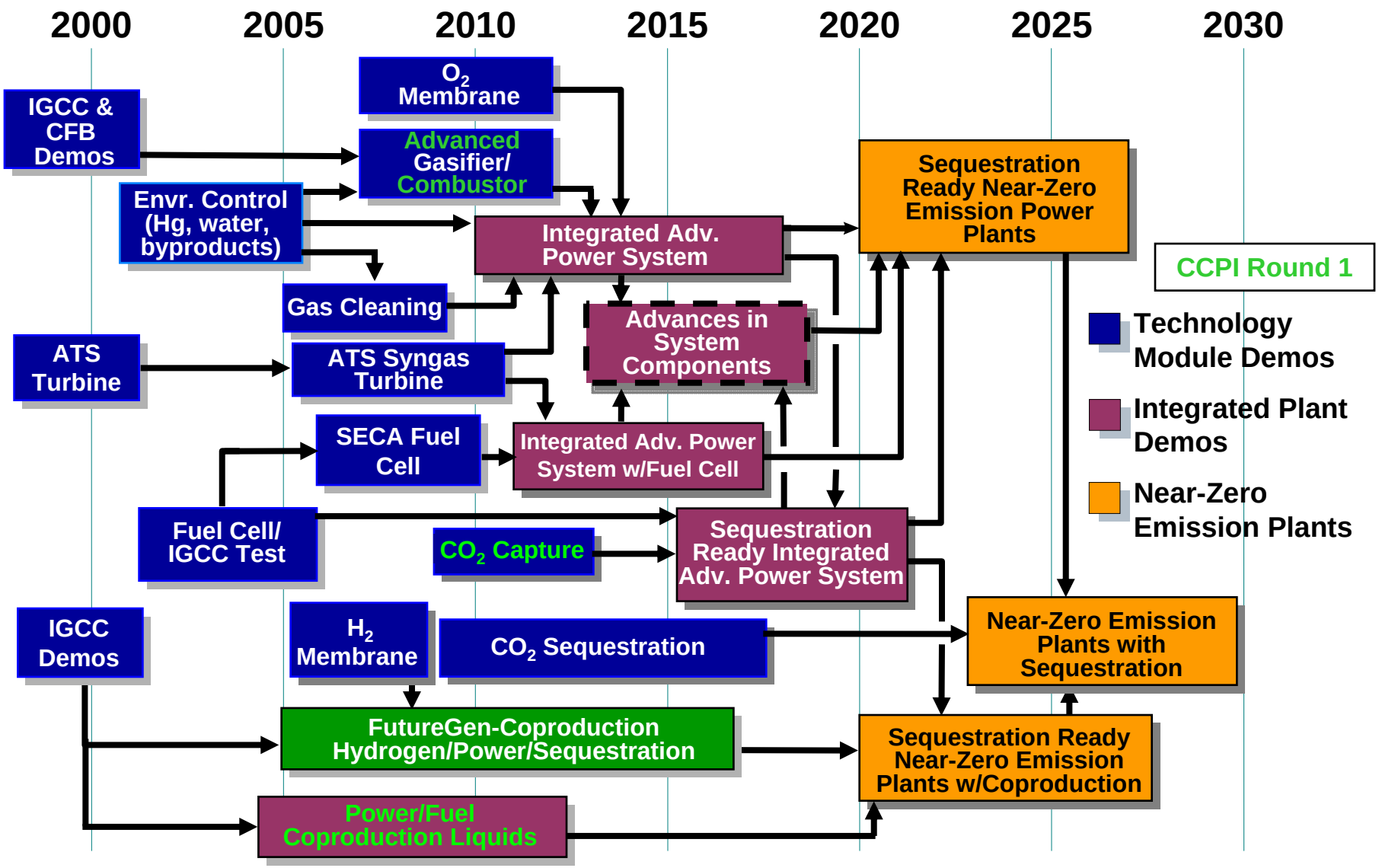
Round 2 (Prioritized)
-Gasification
-Hg Control

- **Technology Demonstration Opportunities**
  - 3P control systems (SO_2, NOx and Mercury)
  - High-efficiency electric power generation
    - Gasification
    - Advanced combustion
    - Fuel Cells and Turbines
  - Retrofit, Repowering and new Merchant Plants

Technology Roadmap – Existing Plants

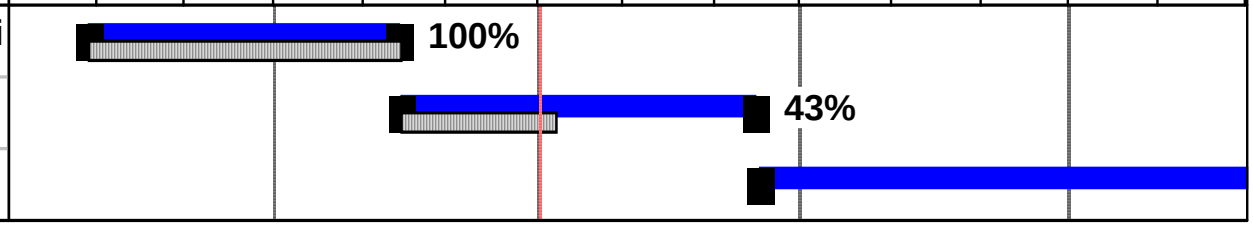


Technology Roadmap – Future Energy Plants



CCPI – Round 2

ID	Task Name	Q4 '03			Q1 '04			Q2 '04			Q3 '04			Q4 '04	
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1	**Prepare/Issue Solicitati**														
14	**Proposal Prep.**														
17	**Evaluation/Selection**														



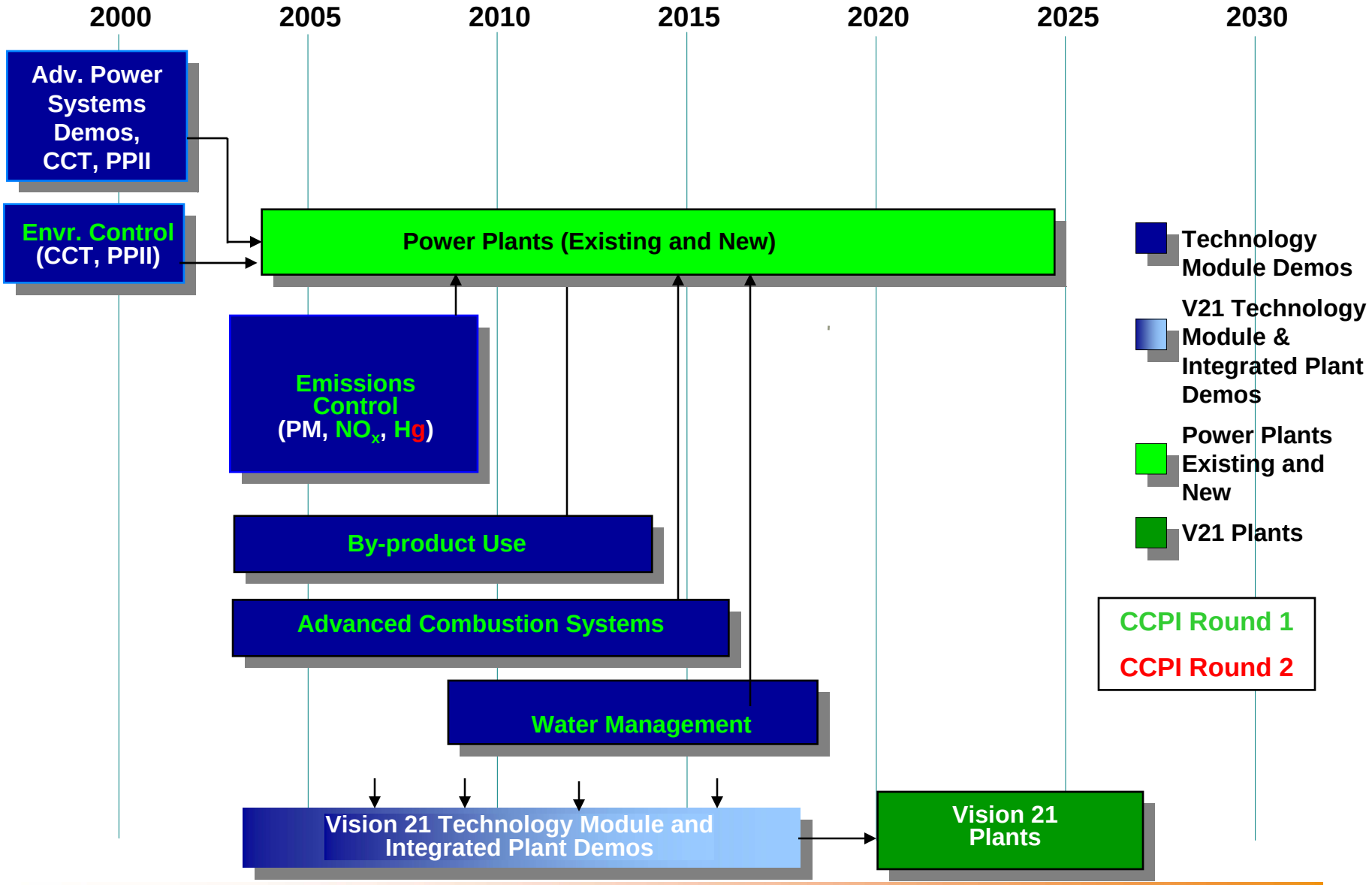
- **Solicitation**
  - Issued February 13, 2004
- **Focus**
  - Hg Control
  - Gasification Technologies
- **Funding**
  - $280 M
- **Proposals**
  - Due June 15, 2004

Interest in CCPI Round 2 is High

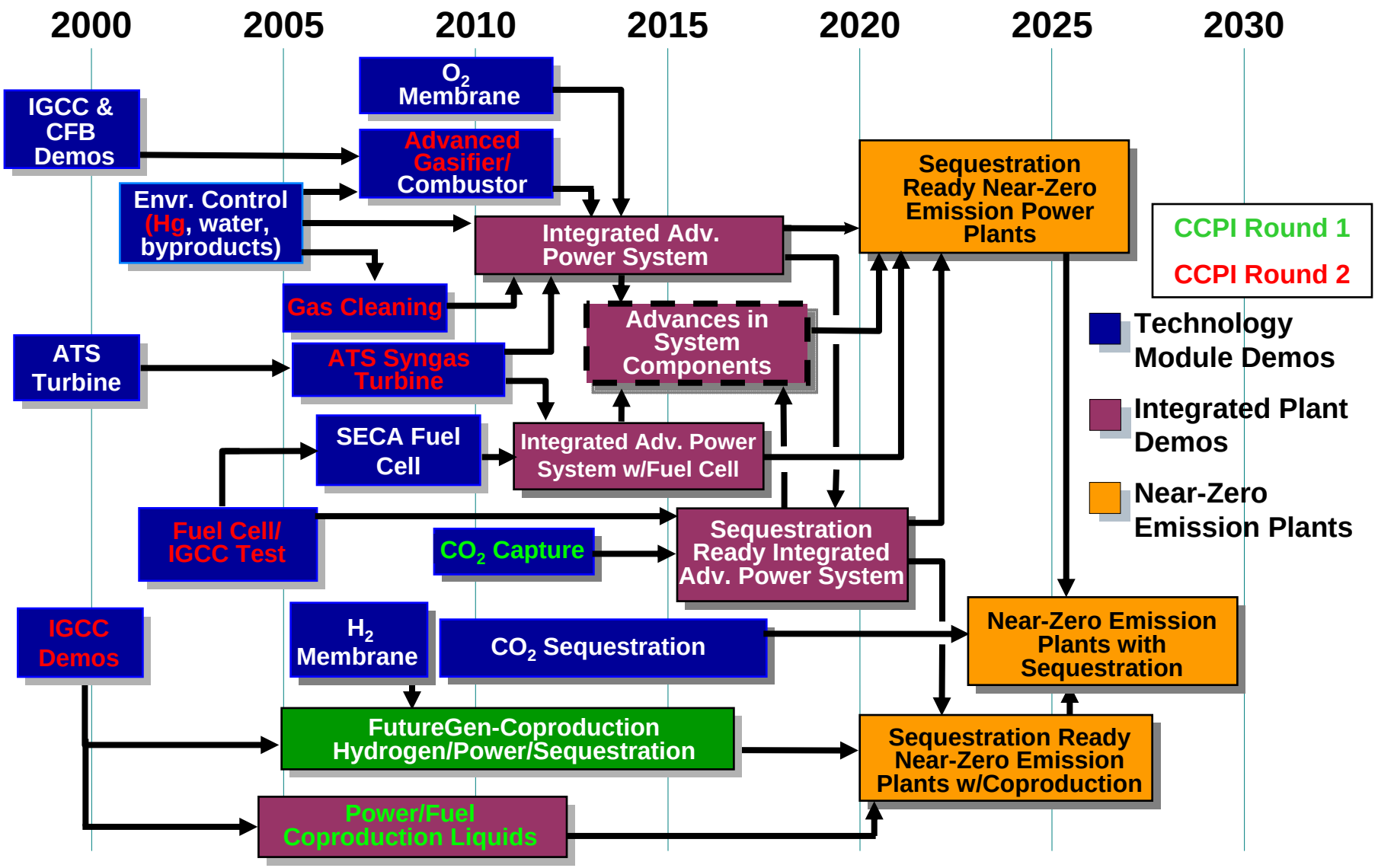
- **Web Activity**
  - **589** IIPS hits on Round 1 (entire posting time)
  - **1650** IIPS hits on Round 2 (in first month)

- **Formal Inquiries**
  - Round 1; 5 Q&A's in 1st month after posting (83 total for entire draft/final cycle)
  - Round 2; 18 Q&A's on draft and 13 on the final (in 1st month)

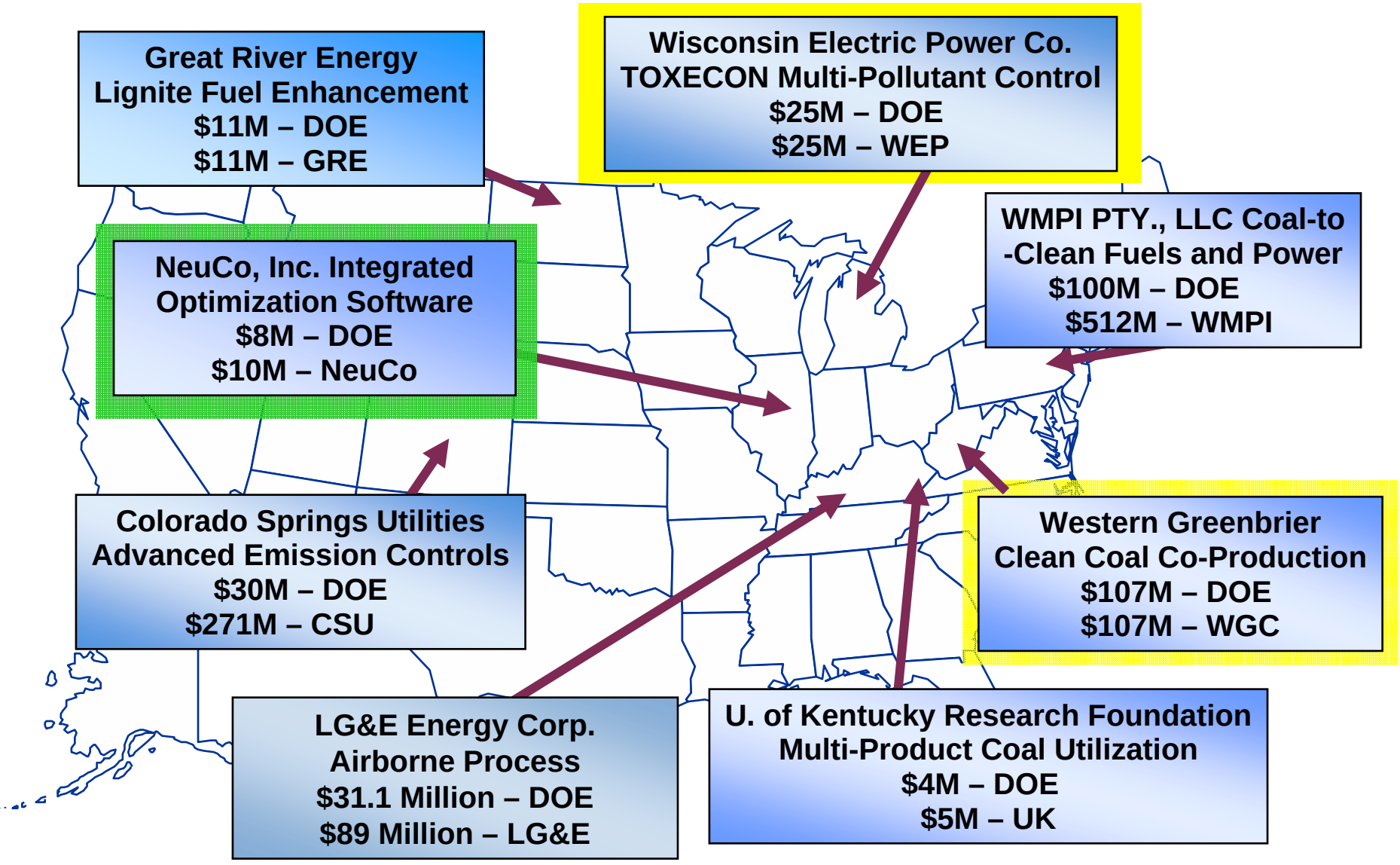
Technology Roadmap – Existing Plants



Technology Roadmap – Future Energy Plants

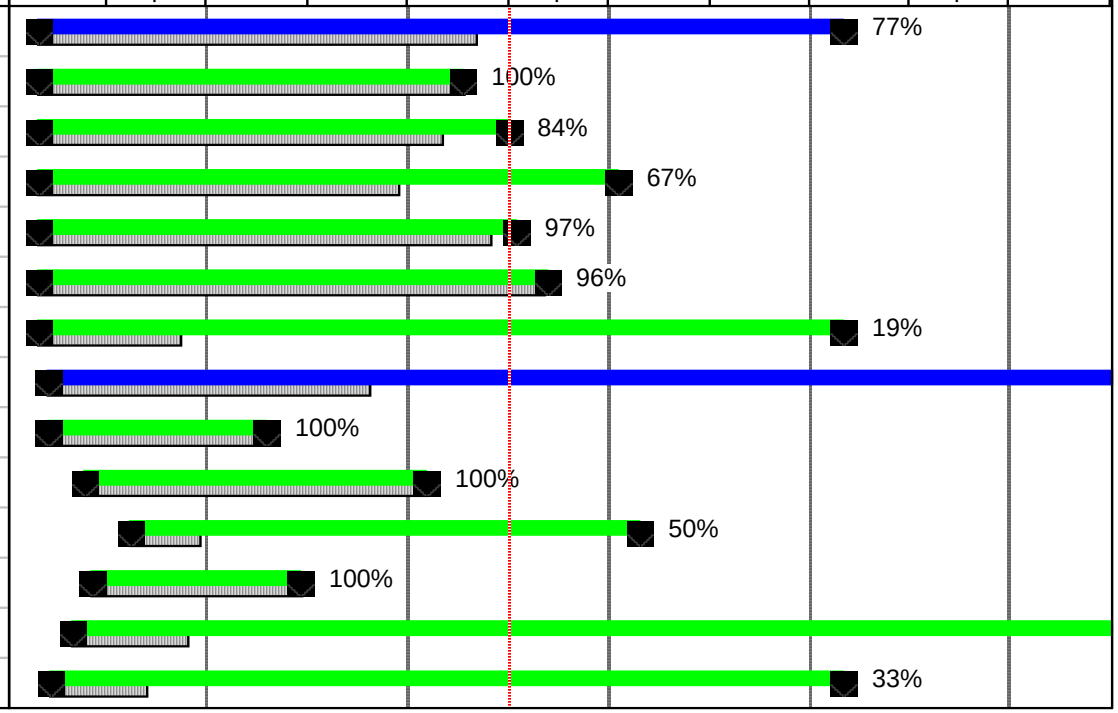


Projects in CCPI – Round 1



CCPI Round 1 Negotiation Status

ID	Task Name
1	**CCPI Round 1 Procurement Packages**
2	Neuco Procurement
69	Great River Energy Procurement
136	U of Ky Procurement
203	We Energies Procurement
270	Western Greenbrier Procurement
337	WMPI Procurement
405	**CCPI Round 1 NEPA Compliance**
406	Neuco NEPA
413	Great River Energy NEPA
420	U of Ky NEPA
427	We Energies NEPA
434	Western Greenbrier NEPA
441	WMPI NEPA



1st Q CY04

NeuCo

2nd Q CY04

WE Energies &

WGC

3nd Q CY04

U of KY &

Great River

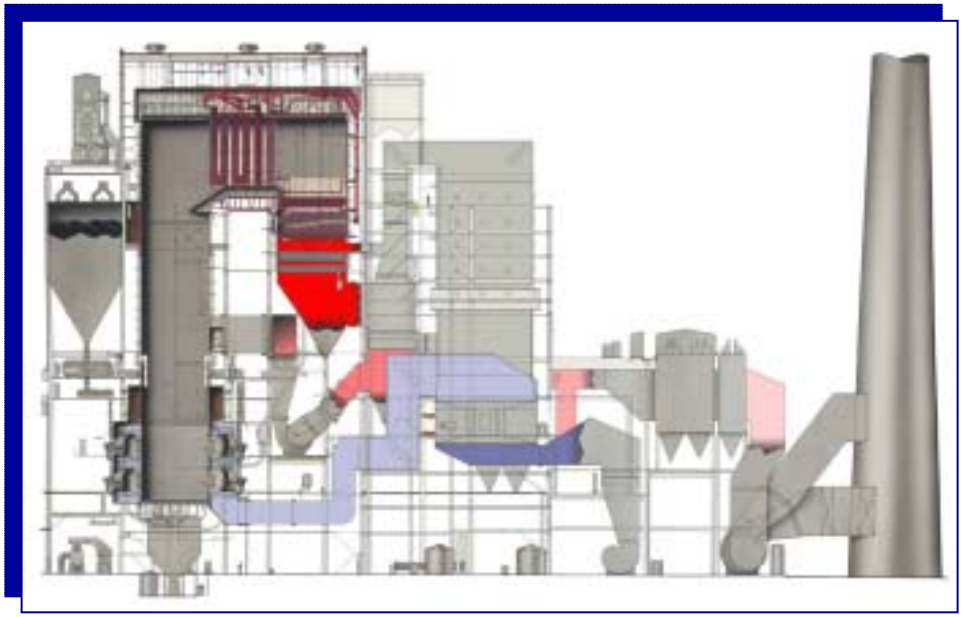
1st Q CY05

WMPI

Award Schedules

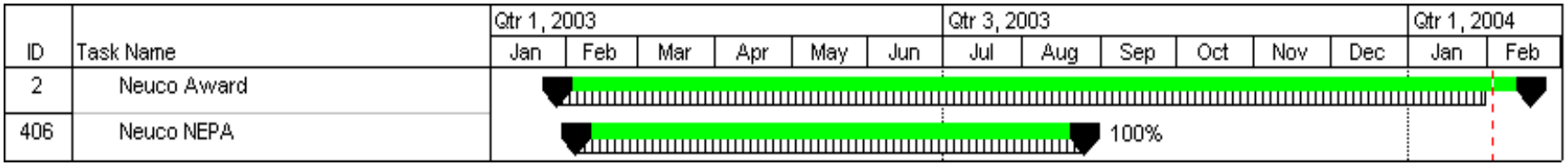
CCPI (1) - NeuCo, Inc.

- Integrated Optimization Software: reduces emissions, increases efficiency, and increases reliability
- Five Modules: cyclone combustion, sootblowing, SCR operations, heat rate performance, profit
- Funding: $18.4>19.1M (DOE: $8.5M, NeuCo internal finance)
- Size: 3 X 600 MW @ Baldwin Plant, Randolph County, Ill
- NeuCo, Inc.: Dynegy Midwest Generation, Inc.



Dynegy Midwest Generation's Baldwin Energy Complex

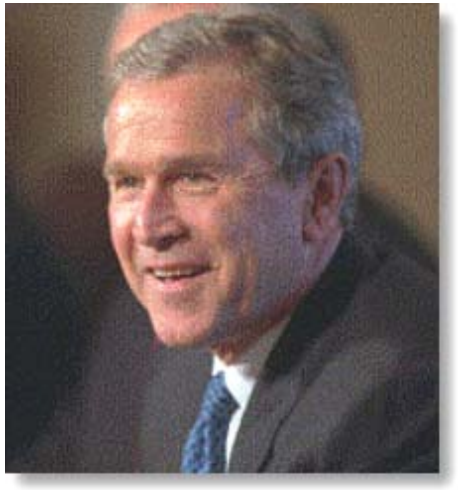
CCPI Round 1-NeuCo



- **Project Schedule – 2004>2008**
  - BP1: 24 months - $9.6 MM (DOE, 45%)
    - Install / operate 5 Module ProcessLink software
  - BP2: 24 months - $9.5 MM (DOE, 45%)
    - Refine / optimize ProcessLink software
- **Repayment**
  - 5% of net sales
- **Roadmap Targets – Existing Plant Technology**
  - Reduce cost of non-SCR NOx control
    - NOx down 5%
  - Reduce COE
    - Efficiency up 1.5%
    - Improved reliability

FutureGen Update

Presidential Initiatives



February 27, 2003

FutureGen Initiative --"…the United States will sponsor a $1 billion, 10-year demonstration project to create the world's first coal-based, zero-emissions electricity and hydrogen power plant …"

January 28, 2003

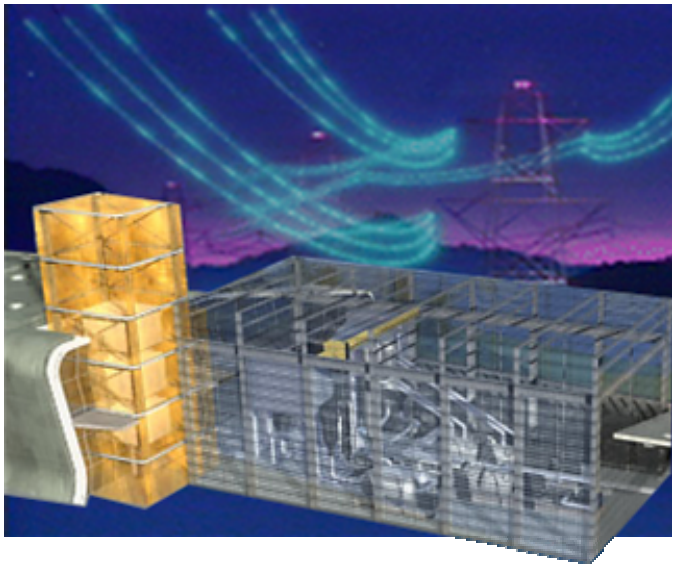
Hydrogen Fuel Initiative – "Tonight I'm proposing $1.2 billion in research funding so that America can lead the world in developing clean, hydrogen-powered automobiles."

February 14, 2002

Clear Skies Initiative -- calls for "… new tough standards to dramatically reduce the three most significant forms of pollution from power plants, sulfur dioxides, nitrogen oxides, and mercury."

Climate Change Initiative – "will set America on a path to slow the growth of our greenhouse gas emissions and, as science justifies, to stop and then reverse the growth of emissions."

Project Description



World's first near-zero emission, coal-based power plant to:

- ✓ *Pioneer advanced hydrogen production from coal*
- ✓ *Emit virtually no air pollutants*
- ✓ *Capture and permanently sequester carbon dioxide*
- ✓ *Integrate operations at full-scale – a key step to proving feasibility*

Goals

1) Operate a full-scale (275 MW) integrated research plant
2) Capture >90% of CO_2 and permanently sequester (1 million tons/year)
3) Prove effectiveness, safety and permanence of CO_2 sequestration
4) Test and validate cutting-edge technologies in "living laboratory"
5) Push toward Clean Coal Technology Roadmap 2020 near-zero emission targets

Near-term Activities – *FutureGen*

FY 2003 Enacted	FY 2004 Enacted	FY 2005 Flat	FY 2005 Request
$0k	$8,889k	$8,889k	$237,000k

- **Key Programmatic Milestones – FY 2004**

Project Activity	*Schedule*	*Status*
– ESAAB approval	1Q/04	complete (with conditions)
– HQ Business Clearance contact	2Q/04	complete
– Deliver *FutureGen* Program Plan to Congress	2Q/04	complete
– Begin fact-finding and negotiation process with Consortium	2Q/04	
– Award CA to Consortium	4Q/04	
– Initiate preliminary design	4Q/04	
EIS Activity		
– Begin to ID environmental issues, & reg. & support contractor requirements	1Q/04	in progress
– Establish EIS Team	3Q/04	in progress
– Issue Advance Notice of Intent	3Q/04	
– Issue formal Notice of Intent	4Q/04	

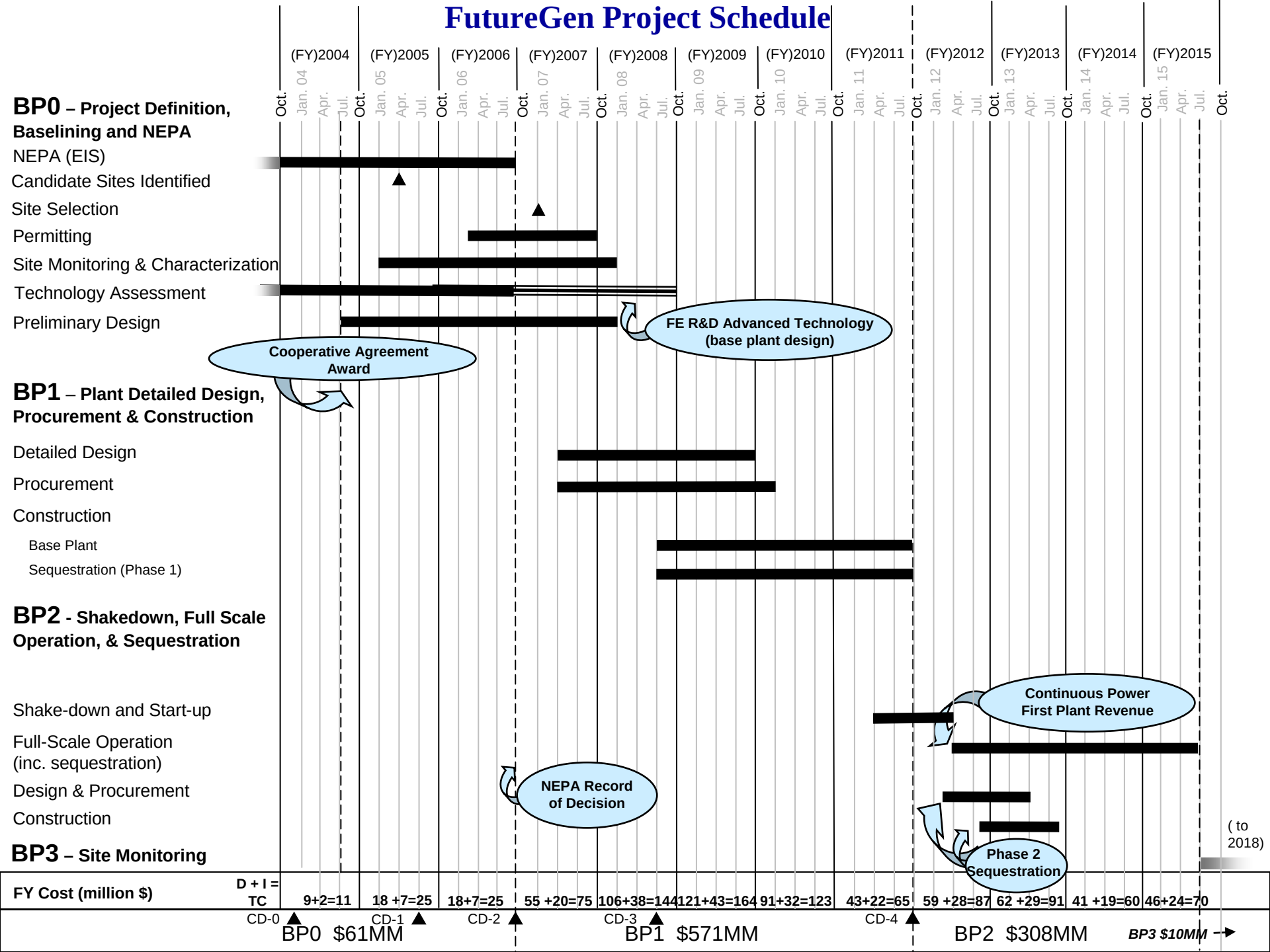
FY 2005Activities – *FutureGen*

FY 2003 Enacted	FY 2004 Enacted	FY 2005 Flat	FY 2005 President
$0k	$8,889k	$8,889k	$237,000k

- **Key Programmatic Milestones – FY 2005**

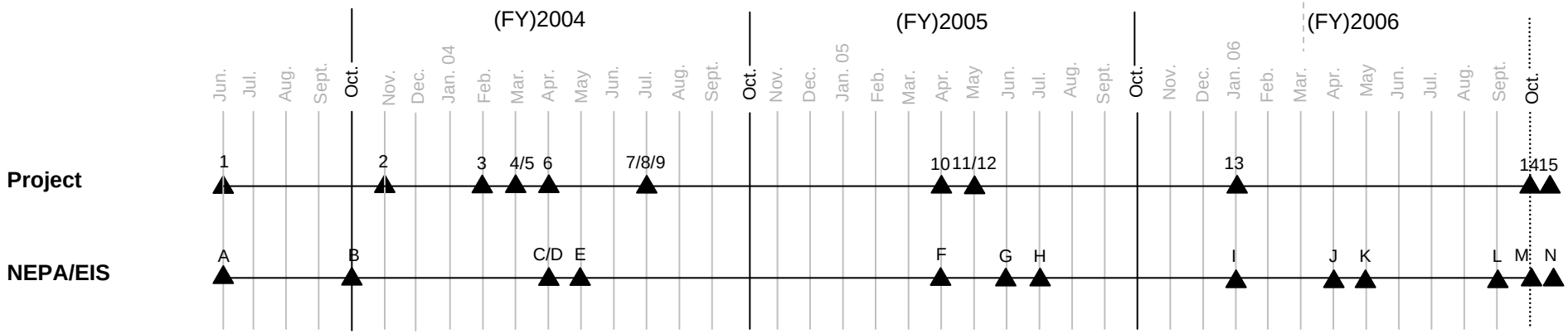
Project Activity	*Schedule*	*Status*
– Consortium identifies candidate sites	3Q05	
– Initiate site monitoring and characterization (candidate sites)	3Q05	
EIS Activity		
– Complete public scoping meetings	4Q05	

FutureGen Project Schedule



Project Milestone Schedule

Super-imposed w/NEPA Activities



MILESTONES:

1 – RFI closes for public comments
2 – Complete ESAAB CD-0 (conditional)
3 – Validate Non-competitive process and execute DNCFA
4 – Issue Program Plan to Congress
5 – Announce selection of Consortium
6 – Resolve CD-0 approval conditions
7 – Initiate preliminary design
8 – Complete negotiation/review of Cooperative Agreement
9 – Award Cooperative Agreement
10 – Identify candidate sites
11 – Deliver initial environmental information
12 – Initiate site monitoring and characterization
13 – Initiate permitting activities
14 – Complete Budget Period 0 – Initiate Detailed Design
15 – Preferred site selected

NEPA ACTIVITIES:

A – Initiate review of comments and environmental planning
B – Initiate identification of environmental issues, regulatory requirements, and support requirements
C – Decision to prepare EIS and initiate consultation
D – Establish EIS team
E – Issue Advance Notice of Intent
F – Issue Notice of Intent to prepare an EIS
G – Complete meetings for public scoping
H – Close public comment period; initiate EIS preparation
I – Issue Draft EIS
J – Complete public hearings on the Draft EIS
K – Close public comment period on the Draft EIS
L – Issue Final EIS
M – Issue Record of Decision
N – Issue Mitigation Action Plan, if required

FutureGen Project Funding & Cost Profile

FY	Appropriations	Expenditures					Key Activities
		DOE Project	*FE R&D*	*Intern'l*	*Industry*	*Total*	
2004	$9	$9	- 0 -	- 0 -	$2	$11	NEPA; Technology Assessment; Preliminary Design
2005	237 (request)	18	- 0 -	- 0 -	7	25	Same as 2004 *plus* Candidate Sites Identified; Site Monitoring
2006	TBD	18	- 0 -	- 0 -	7	25	Complete NEPA; Start Permitting; Continue Monitoring and Preliminary Design
2007	TBD	50	- 0 -	5	20	75	Select Preferred Site; Continue Technology Assessment; Monitoring; Preliminary Design; Permitting
2008	TBD	100	- 0 -	6	38	144	Complete Permitting, Monitoring and Preliminary Design; Start Detailed Design and Procurement
2009	TBD	113	- 0 -	8	43	164	Complete Detailed Design; Start Construction
2010	TBD	81	- 0 -	10	32	123	Complete Procurement and Continue Construction
2011	TBD	13	20	10	22	65	Complete Construction; Start Shakedown and Sequestration
2012	TBD	29	20	10	28	87	Complete Shakedown; Start Full-scale Operation; Start Phase 2 Sequestration
2013	TBD	32	20	10	29	91	Full-scale Operation and Phase 2 Sequestration
2014	TBD	18	16	7	19	60	Introduce and Validate Advanced Technologies
2015	TBD	19	20	7	24	70	Introduce and Validate Advanced Technologies; Start Long-term Monitoring
2016 – 2018	TBD	- 0 -	- 0 -	7	3	10	Long-term Monitoring
Total	***$676***	***$500***	***$96***	***$80***	***$274***	***$950***	

FutureGen Test Plan

- **Base plant technologies**
  - Oxygen production
  - Gasification
  - Gas separation & clean-up
  - Steam and combustion turbines
  - Alternate feedstocks (coal types)
- **Advanced cutting edge technologies** *("living laboratory")*
  - ITM oxygen production
  - Hydrogen production
  - Hydrogen combustion turbines
  - Fuel cells and hybrids
- **Sequestration system (Phase 1)**
- **Sequestration system (Phase 2)**
- **Long-term monitoring**

NETL to Draft Test Plan outline and provide it to Consortium early in engagement activities

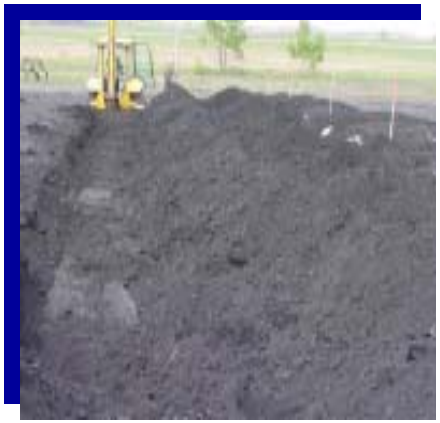
Key Issues

- ✓ **Funding availability**
  - ~$9M in FY04 funding contingent upon delivery of Program Plan to Congress (+30 days) and Congressional briefings
- ✓ **Consortium organizational development awaiting outcome of DOE out-year funding commitment**
- ✓ **Cost sharing**
  - Consistent with EPACT R&D; Industry indicated willingness to invest only $200M; no expectation of return on investment – “missionary work” for coal industry and public; net vs. gross DOE funding; current plan calls for additional cost-sharing
- ✓ **Sequestration introduces complexities**
  - Site selection, ES&H, NEPA, and public perception
- ✓ **Consortium pre-award engagement**
  - Identify key business issues and critical path project activities

Back-up Information

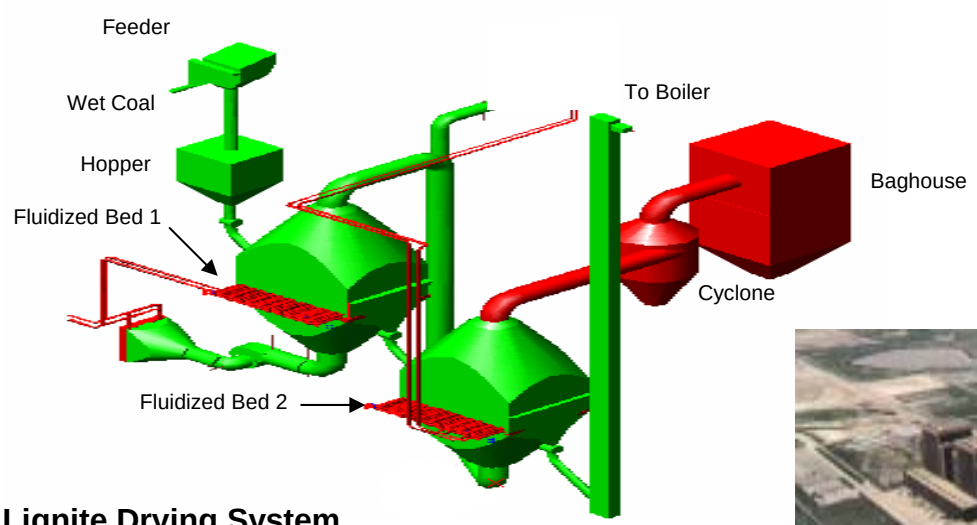
CCPI (1) - Great River Energy

- Lignite fuel enhancement: reduces moisture using low temp waste heat
- Funding: $22>28M (DOE $11M, GRE Internal / RUS loan)
- Size: 546 MW in 6 trains @ Coal Creek Station, North Dakota
- GRE : EPRI : Lehigh U. : Barr Eng. : Falkirk Mining and Couteau Properties



Lignite Coal

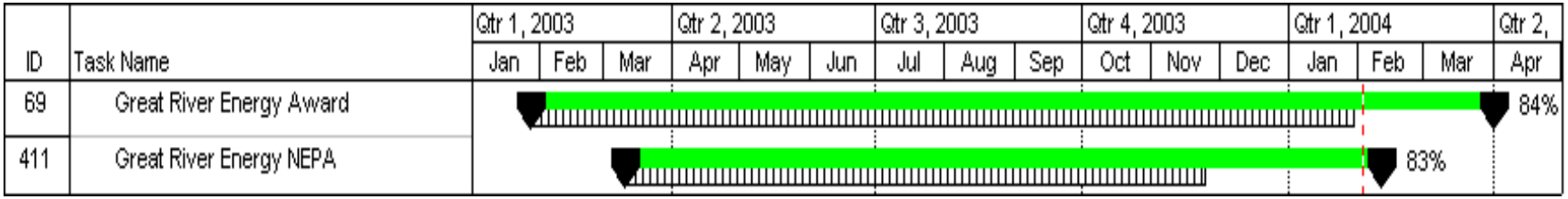
Two-Stage Fluidized Bed Dryer System using Waste Heat



Lignite Drying System

Coal Creek Station
Underwood, ND

CCPI Round 1 - Great River Energy

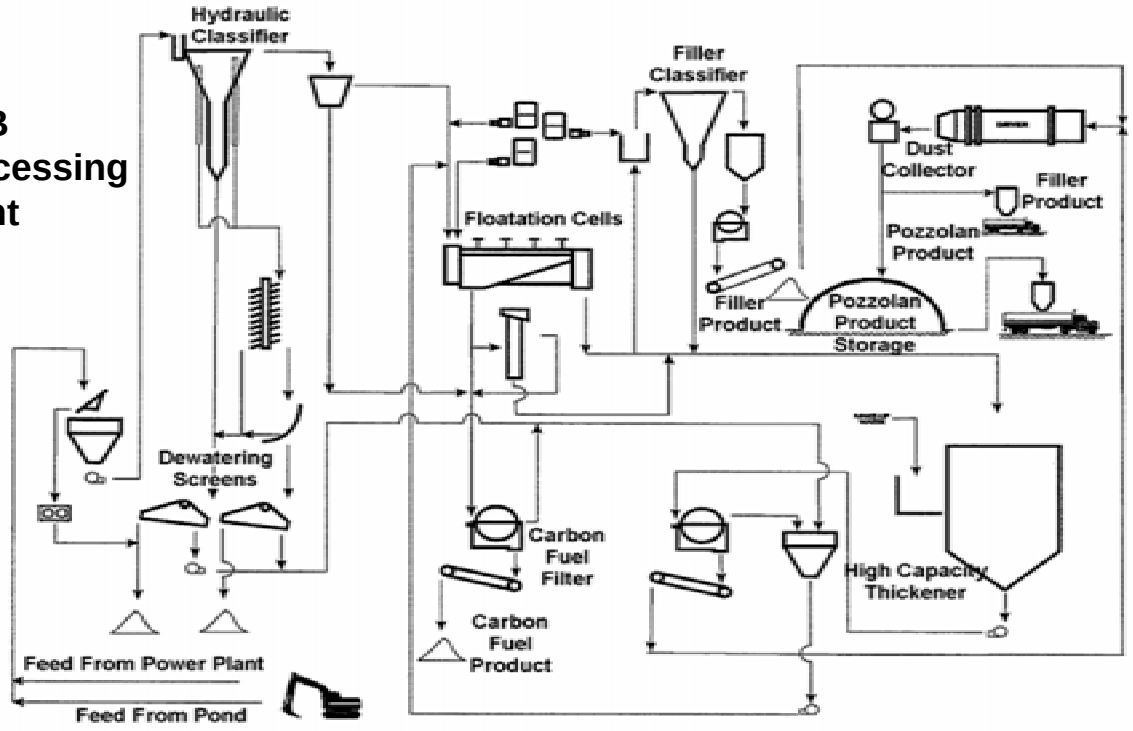


- **Project Schedule – 2004>2007**
  - BP1: 9 months - $4.4 M (DOE,50%) – prototype dryer
  - BP2: 12 months - $9.6 M (DOE 37%) – 3 additional dryers
  - BP3: 12 months - $11.2 M (DOE 37%) – 3 additional dryers
  - BP4: 12 months - $1.1 M (DOE 37%) – full plant operation
- **Repayment**
  - ½ GRE – annual direct payment
  - ½ license sale – GRE through Barr Engineering
- **Issues**
  - Finalizing cost – resolved
- **Roadmap targets – existing plant technology**
  - Reduce COE
    - Efficiency up 2.8% improved reliability
  - Reduced make-up water

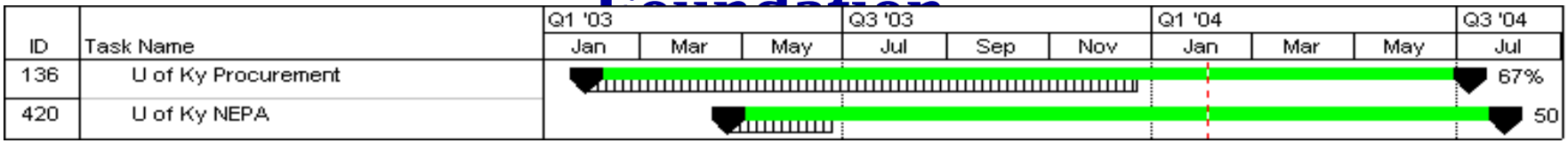
CCPI (1) - University of Kentucky Research Foundation

- Ash Beneficiation: Uses all CUB's – makes variety of products.
- Funding: $8.9M (DOE $4.4M, CERMEX/LG&E/UKRF Internal)
- Size: 2,200MW@ Ghent Plant - Kentucky
- UKRF : CERMEX : LG&E

CUB Processing Plant



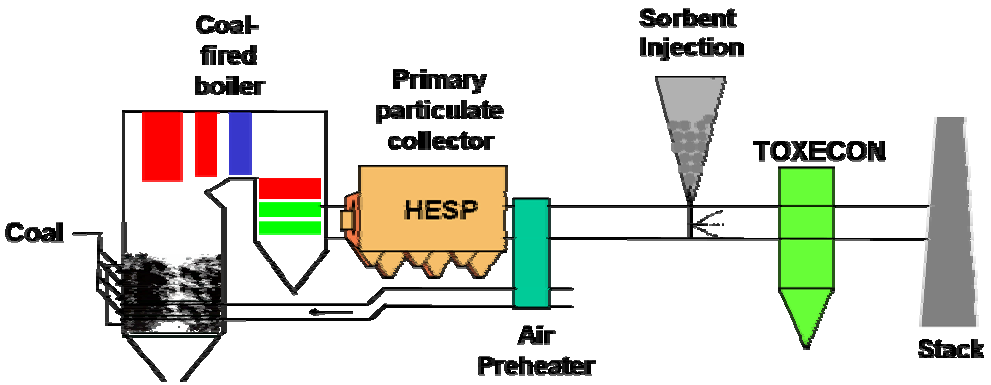
CCPI Round 1 – U of KY Research Foundation



- **Project Schedule – 2004>2008**
  - BP1: 18 months - $1.2M (DOE 50%) – project definition
  - BP2: 6 months - $0.6M (DOE 50%) – design
  - BP3: 12 months - $6.2M (DOE 50%) – construct > shakedown
  - BP4: 12 months - $0.9M (DOE 50%) – operation
- **Repayment**
  - UKRF: 0.5% equipment sales + 5.0% royalties/license
  - CERMEX: 5.25% pozzolan + 3.5% sand + 7.5% polymeric + 4.0% fuel
- **NEPA**
  - EA – waiting LG&E site info
- **Issues**
  - Industrial partner – resolved
  - Repayment agreement – almost resolved
  - Site access / product sales – being negotiated
- **Roadmap targets – existing plant technology**
  - CUB utilization
  - Indirectly CO_2 management (cement production offset)

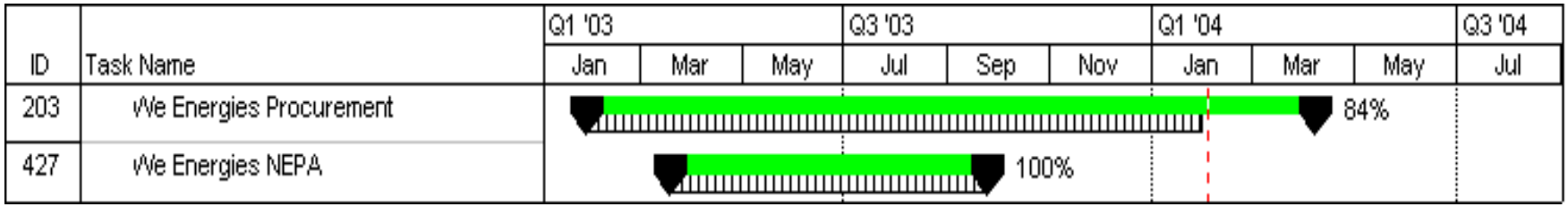
CCPI (1) - Wisconsin Electric Power Company

- Toxecon: Integrated Hg, NOx, SO2 and particulate control
- Other: Continuous emissions monitor, Hg recovery
- Funding: $49.5M (DOE 24.7M, WeEng internal – subject to PUC approval)
- Size: 270 MW @ Presque Isle Plant – Marquette, MI
- WeEng : ADA-ES : Cummins & Barnard : Environmental Elements Corp : EPRI



Presque Isle Power Plant

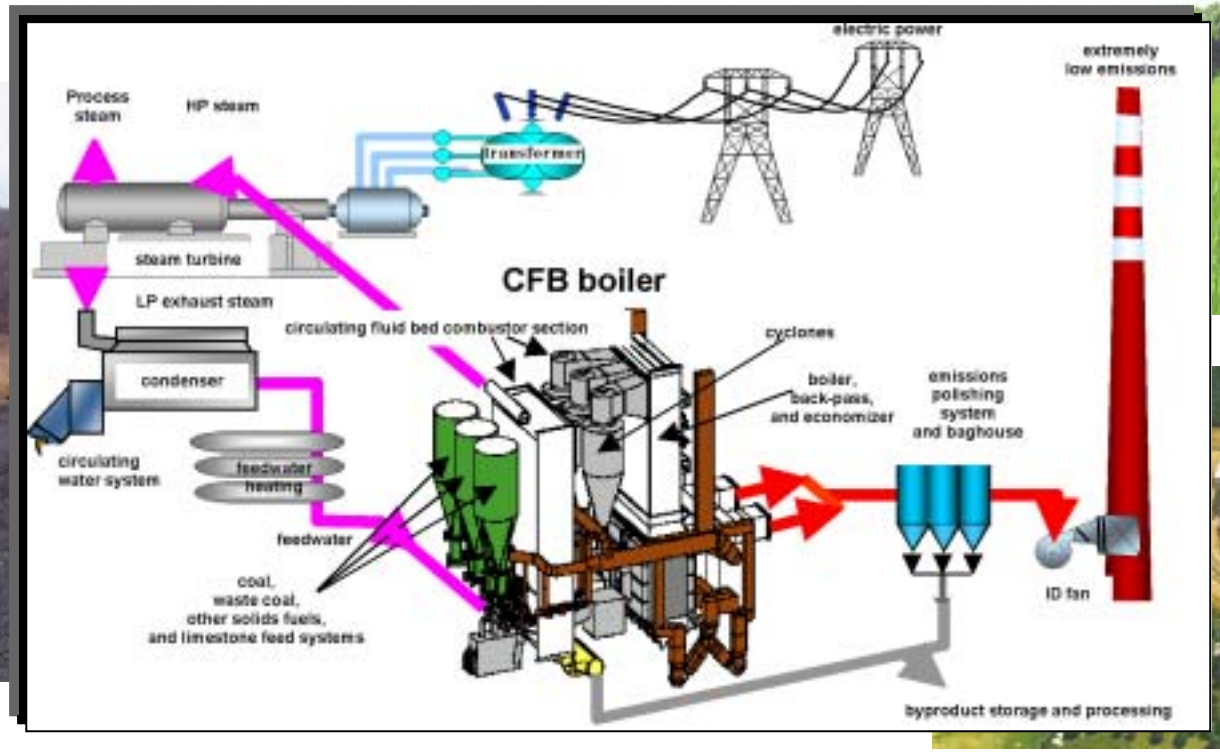
CCPI Round 1 – WE Energies



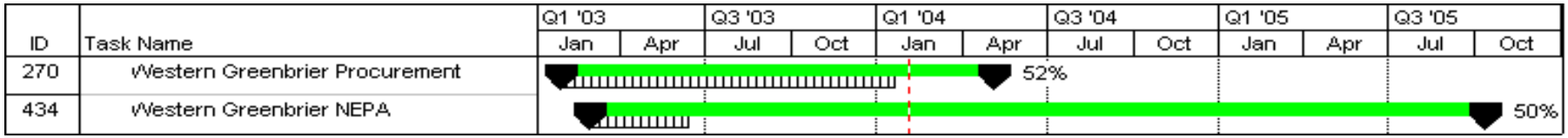
- **Project Schedule – 2004>2009**
  - BP1: 9 months - $12.4M (DOE 50%) – design, long lead, foundation const.
  - BP2: 64 months - $37.1M (DOE 50%) – const., operation, CEM, Hg rec'ry
- **Repayment**
  - ADA-ES: 15% sorbent + 5% CEM + 5% injection systems sales
  - EPRI: 0.25% toxecon + 5% injection sales from licensed vendors.
- **Issues**
  - Repayment flow down – almost resolved
  - Audit findings – being negotiated
  - PUC approval – waiting decision
- **Roadmap targets – existing plant technology**
  - Hg Control 90%
    - Keeps ash a saleable CUB

CCPI (1) - Western Greenbriar Co-Generation, LLC

- Adv. FBC + CUB utilization
- Anchor tenant for “Eco Park”; remediation model for coal gob piles
- Funding: $215M (DOE: $107.5M, WGC Debt + Partners Internal)
- Size: 85MW @ Rainelle, WV
- WGC : Alstom : Hazen Research : Parsons : Midway Environmental



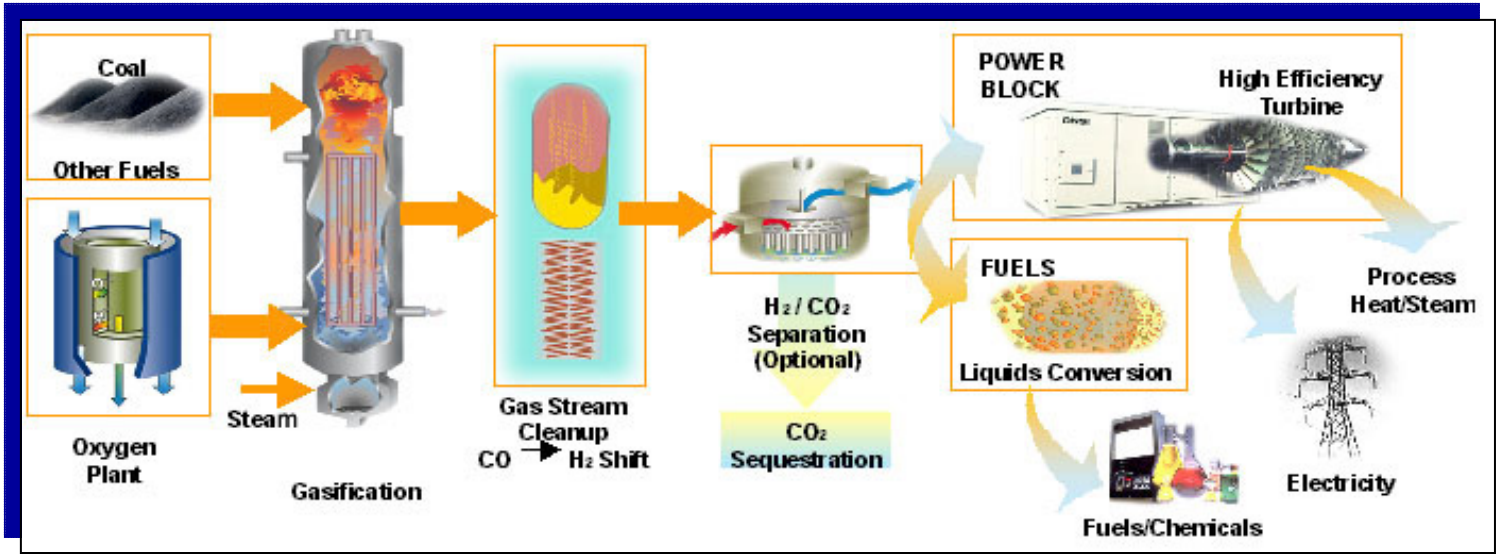
CCPI Round 1 – WGC



- **Project Schedule – 2004>2009**
  - BP1: 17 months - $ 12M (DOE 50%) – project definition
  - BP2: 45 months - $200M (DOE 50%) – design, const.
  - BP3: 16 months - $ 3M (DOE 50%) – operation
- **Repayment**
  - WGC – annual direct payment (Subject to DOE reopening)
- **Issues**
  - Technology - resolved
  - Financing BP1 - resolved
  - Repayment - resolved
  - Cost - almost resolved
  - Site – almost resolved
  - Legal – almost resolved
  - SOW – almost resolved
- **Roadmap targets – existing plant technology**
  - CUB utilization
  - Advanced combustion

CCPI (1) - Waste Management and Processors Inc.

- Gasify waste coal to make power, steam, and liquid fuels.
- Funding: $612M (DOE: $100M, WMPI uncertain)
- Size: 4,700 tpd coal waste, 41 MWe, 5,000 bpd fuel @ Gilberton, PA
- WMPI : Shell : Uhde : SASOL : Nexant

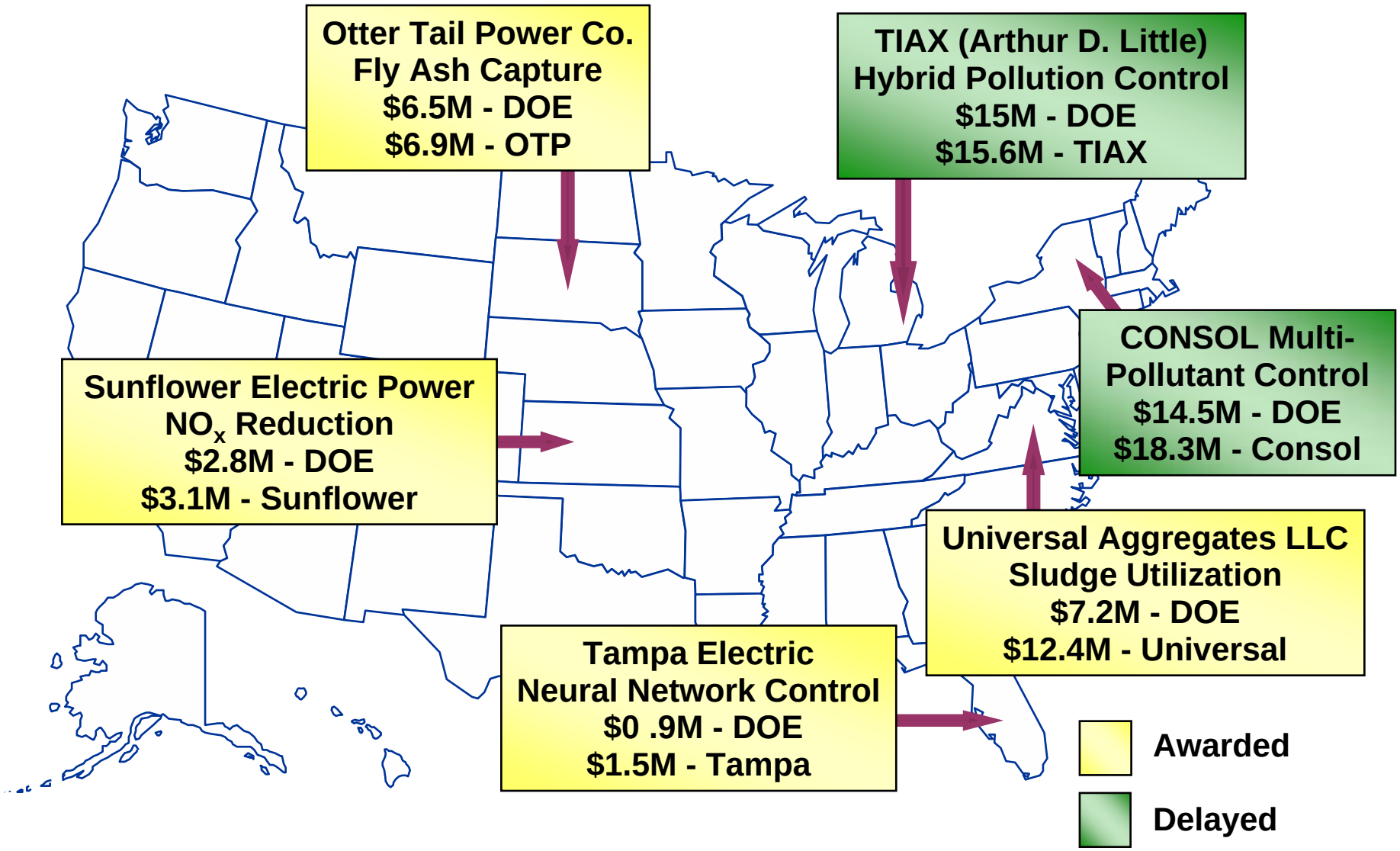


CCPI Round 1 – WMPI

ID	Task Name	Q1 '03		Q3 '03		Q1 '04		Q3 '04		Q1 '05		Q3 '05	
		Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct
337	WMPI Procurement									19%			
441	WMPI NEPA									33%			

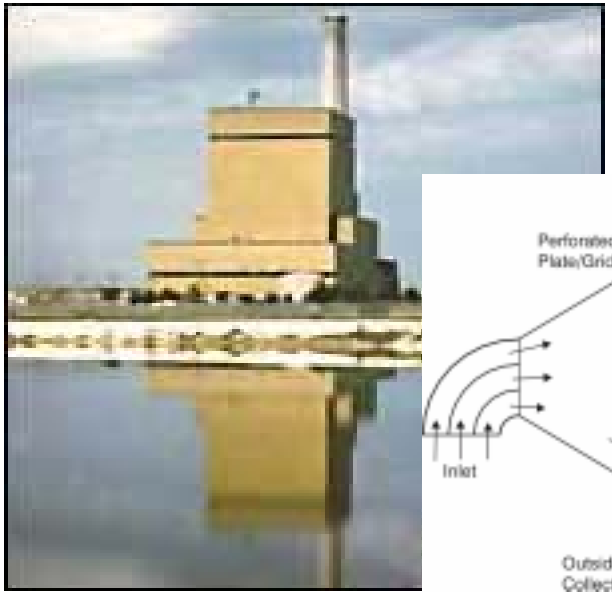
- **Project Schedule – 2005>2011**
  - BP1: 16 months - $ 61M (DOE 43%) – project definition, design
  - BP2: 31 months - $535M (DOE 13%) – construction
  - BP3: 25 months - $ 16M (DOE 10%) – operation
- **Repayment**
  - WMPI – annual direct payment
- **Issues**
  - IP, cost, financing, SOW – being determined / negotiated
  - NEPA - EIS
- **Roadmap targets – integrated plant technology**
  - Power + fuel with CO_2 capture

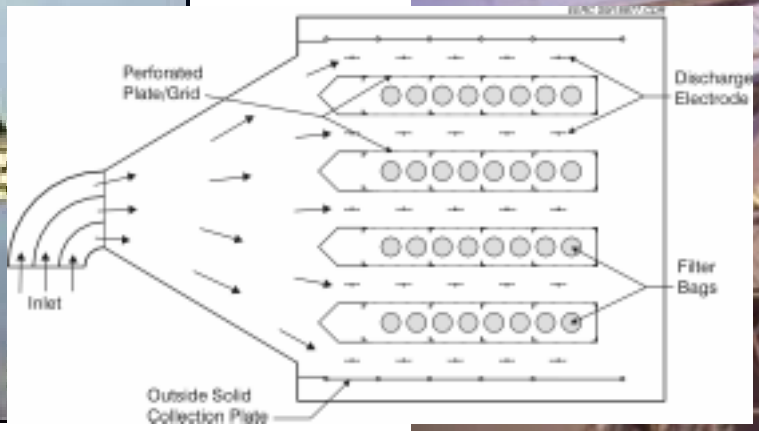
Six PPII Projects

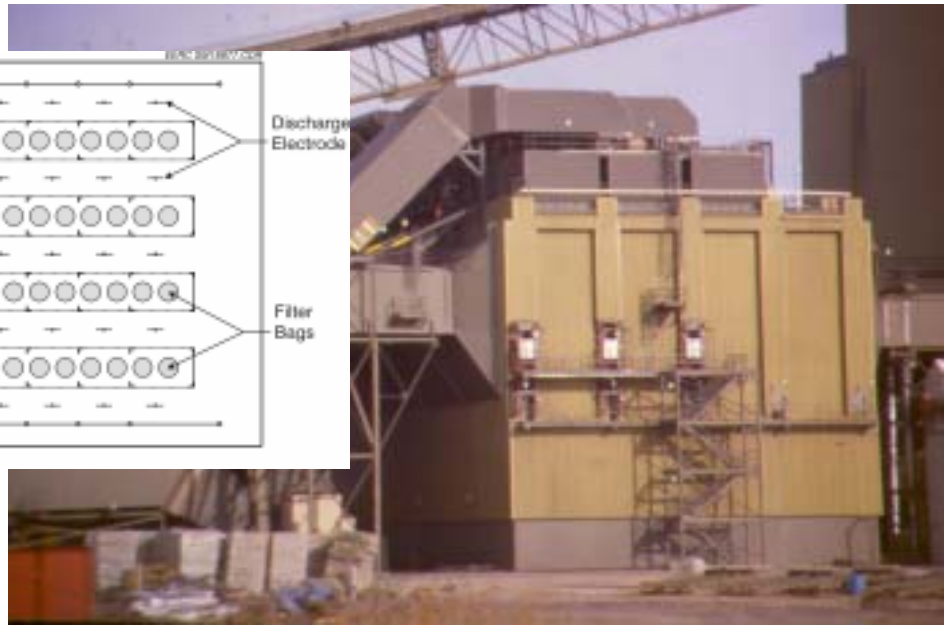


PPII – Ottertail Power

- AHPC = ESP + Bag Filter
- Funding: $13.4M ($6.5M DOE, Ottertail/Gore)
- Size: 450 Mw @ Big Stone City, SD
- Montana-Dakota Utl. : NW Public Serv. : W.L. Gore : UND/EERC







PPII – Ottertail Power

- **Project Schedule – 2001> 2004**
  - BP1: 35 months - $13.4 M (DOE 49%) design, const., operation
- **Repayment**
  - Gore: % of new and retrofit applications worldwide
- **IP**
  - UD/EERC - AHPC technology
  - Gore - fabric filter technology
- **Roadmap Targets – Existing Plant Technology**
  - Environmental control - particulate

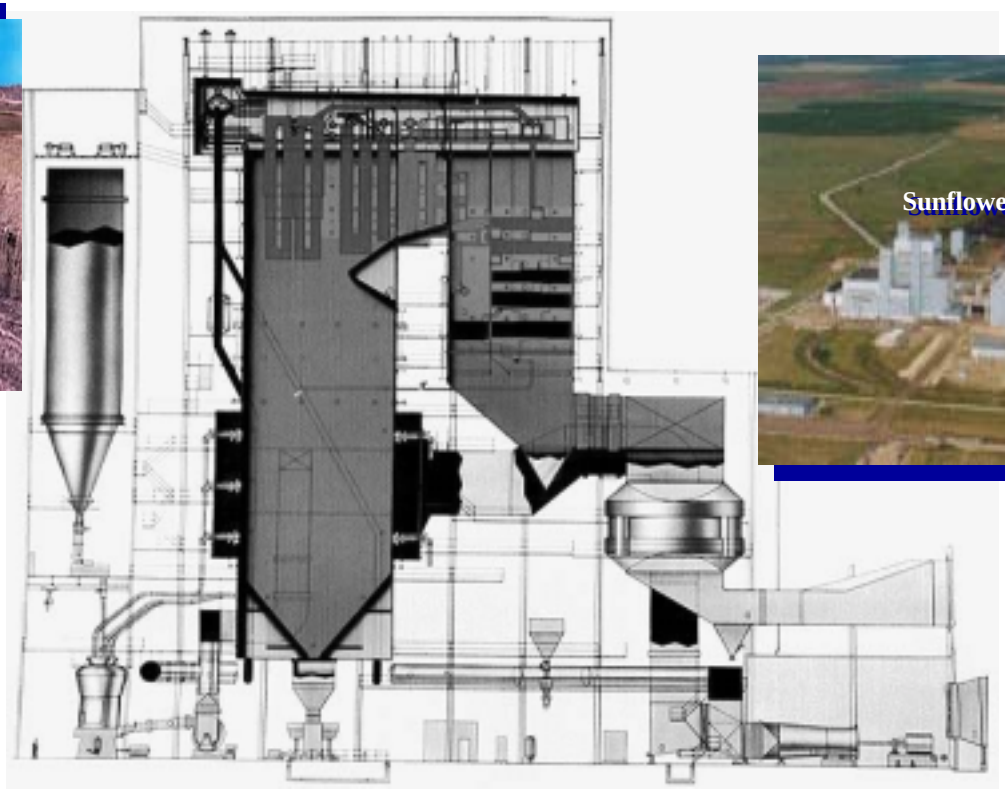
PPII – Ottertail Power

- **Accomplishments**
  - EA completed June 2002
  - Startup and preceding activities completed on schedule-Oct 2002
- **Findings**
  - Particulate removal very good
  - Pressure drop and filter bag life are issues
- **Future**
  - Otter Tail to brief NETL on status and plans April 2004
- **Issues**
  - Budget and plan forward

PPII - Sunflower Electric Power Company

- Integrated combustion optimization system – NOx control & increased efficiency
- Funding: $5.9 million ($3.1M Sunflower Electric Power Corp.)
- Size: 360 MWe @ Holcomb Station, Finney KS
- Sunflower EPC, GE EER

PRB Coal



PPII - Sunflower EPC

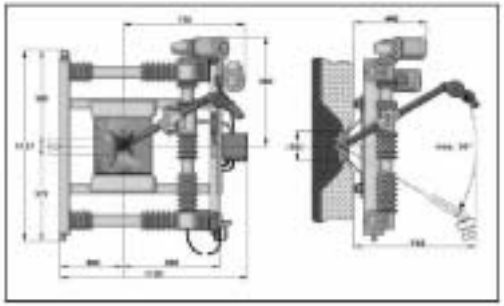
- **Project Schedule – 2001> 2005**
  - BP1: 17 months- $3.0M (DOE 46%) - advanced sensors upgrade, low NOx burner modifications, coal-balancing dampers installation
  - BP2: 16 months – $2,9M (DOE49%) – Advance Overfire Air (OFA) System
- **Repayment**
  - Sunflower - % power sold (MWh) from the 354th MW through 360th MW
- **IP**
  - GE-EER
- **Roadmap Targets – Existing Plant Technology**
  - Environmental control – NSPS NOx control

PPII - Sunflower EPC

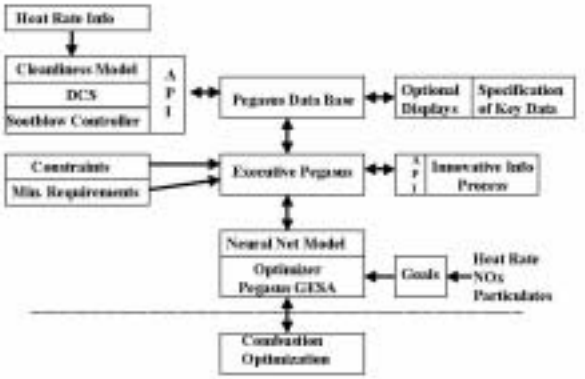
- **Accomplishments**
  - Advanced sensors upgrade complete
  - Low NOx burner modifications complete
  - Coal-balancing dampers installation complete
  - Retrofited one mill with automated coal-balancing system
- **Findings**
  - Possibility of using sensors to balance fuel and air flow in real time
- **Future**
  - Implementation of OFA system
  - Retrofit remaining for four mills with automated coal-balancing system
- **Issues**
  - Resolving OFA impacts on boiler performance
  - Resolving financial matter of cost escalation for OFA system

PPII – Big Bend Station

- Neural Network - Sootblower – NOx control & increased efficiency
- Funding: $2.4million ($1.5M Tampa Electric)
- Size: 450 MWe @ Big Bend Station, Hillborough, FL.
- Tampa Electric : Pegasus Technologies, Inc



Typical water cannon mechanism



Process Schematic

PPII – Big Bend Station

- **Project Schedule – 2002>2005**
  - BP1: 32 Months - $2,4M (DOE 38%) – design, install, operation
- **Repayment**
  - Pegasus - 5% of royalty / licensing fees + 0.5% gross revenues from sale/lease
- **IP**
  - Pegasus Technologies
- **Roadmap Targets – Existing Plant Technology**
  - Environmental control – NSPS NOx control

PPII – Big Bend Station

- **Accomplishments**
  - Parametric testing completed
  - NN-ISB system installed/operating at Big Bend
- **Findings**
  - NOx reductions 10-20%
  - Improvement in heat rate ~1%
- **Future**
  - Refinement/improvements identified for implementation
- **Issues**
  - Water cannons – material problem resolved, coverage being addressed
  - Heat flux sensor – material problem being addressed

PPII – Universal Aggregates

- Aggregate from spray dryer byproduct – utilization of coal byproduct
- Funding: $19.6million ($12.4M Universal Aggregates,LLC)
- Size: 250 MW @ Birchwood Power Plant, King George County, Va.
- SynAggs = Universal Aggregates, LLC

Birchwood Power Facility

Sample Aggregate

Storage Silo for Spray Dryer By-product

PPII – Universal Aggregates

- **Project Schedule – 2002>2005**
  - BP1: 5 Months - $1.3M (DOE 50%) – design
  - BP2: 9 Months - $11.4M (DOE 50%) – construction, start-up
  - BP3: 16 Months – $6.9M (DOE 12/6%) - operation
- **Repayment**
  - Universal Aggregates LLC
    - 0.5% of gross revenue from sale of aggregate
    - 0.5% of gross revenue from sale of equipment for aggregate production
    - 5.0% of royalty and license fees
- **IP -** Universal Aggregates LLC
- **Roadmap Targets – Existing Plant Technology**
  - Utilization of coal byproduct

PPII- Universal Aggregates

- **Accomplishments –**
  - NEPA completed 11/02
  - Design completed 3/03
  - Construction completed 1/04
  - Shakedown begun 2/04
- **Issues –**
  - Consol has sold their half of project to SynAggs LLC

CCT Projects

- **Terminated by Mutual Agreement**
  - CPICOR – direct reduction iron making
- **Completed**
  - Tampa, Polk IGCC
  - SoCo, wall-fired boiler
- **On-Going**
  - TIAX – coal diesel
    - Two cylinder engine tests with coal water slurry
      - AK – Sub-bituminous
      - KY – Bituminous
  - JEA – CFBC
    - Test underway, completion scheduled for August 2004
  - Kentucky Power – IGCC / fuel cell
    - FC @ Walbash delayed until May 2004
    - IGCC @ KY site & finance issues being resolved

FutureGen – A "Zero-Emissions" Coal Plant

FutureGen:

- ✓ ***will test new technologies to capture CO_2 at power plant***
- ✓ ***will test large-scale injection into oil fields or into deep geologic formations for permanent storage***